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Jensen, Mette Krog; Skov, Anne Ladegaard; Rasmussen, Henrik K.; Hassager, Ole

Publication date:
2010

Document Version
Publisher's PDF, also known as Version of record

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Citation (APA):
Jensen, M. K., Skov, A. L., Rasmussen, H. K., & Hassager, O. (2010). *Reversible planar elongational of soft polymeric networks*. Abstract from 6th Annual European Rheology Conference, Göteborg, Sweden.

Reversible Planar Elongation of Soft Polymeric Networks

Mette Krog Jensen, Anne Ladegaard Skov, Henrik Koblitz Rasmussen, Ole Hassager
Department of Chemical and Biochemical Engineering, DTU, Department of Mechanical Engineering, DTU, Department of Chemical and Biochemical Engineering, DTU

The newly developed planar elongation fixture, designed as an add-on to the filament stretch rheometer, is used to measure reversible large amplitude planar elongation on soft elastomers. The concept of the new fixture is to elongate an annulus by keeping the perimeter constant. The deformation on the cylindrical probe is measured using digital imaging, and it is found that the diameter drops a few percent only compared to the initial diameter. Additionally it is found that a new approximation to the Doi-Edwards (DE) model, without independent alignment, captures the experimental data very well. In particular it is observed that this new approximation reproduces the order of magnitude of the deformation on the cylindrical probe, and by that we confirm our previous statement: That the deformation on the cylindrical probe is highly sensitive towards the choice of strain tensor. When analyzing the measured stress data, it is observed that there is some elastic recovery when reversing the flow. This is analyzed calculating the amount of work needed during the deformation, and it is observed that the sample itself contributes with work upon flow reversal. The stress is well described by both the modified Lodge model and the new approximation to the DE model, which leads to the conclusion that the stress is time-strain separable. This demonstrates that the energy loss is due to linear viscoelastic relaxation, and can be determined solely from linear viscoelastic measurements.

Semi-crystalline polymers: counting nuclei with rheometry

Gerrit W. M. Peters, Rudi J. A. Steenbakkers, Zhe Ma
Eindhoven University of Technology

Adding nucleating agent (NA) into a crystallizable polymer system is a common way to control crystallization and tailor mechanical and optical properties of products. These properties are closely related to the resulting nucleus density. For colored NA systems, nucleus density becomes too large and subsequently changes the optical properties, both making it impossible to quantify nucleation density using optical microscopy. The aim of this work is to develop a new method to determine the nucleus density for colored NA systems by applying rheometry. It is based on a linear viscoelastic suspension model derived from the three dimensional generalized, self-consistent method (3D GSCM) of Christensen and Lo. This model has been validated by experimental data in our previous work. It is shown that the method gives results consistent with optical microscopy (for those conditions where OM applies) and works well for quiescent and flow enhanced nucleation of filled polymeric systems.